



## Sensors

# Cryogenic and Non-Cryogenic Optical Liquid Level Instrument for Stratified Conditions

A simplified, cost-saving measurement device using optical transmission properties

NASA's Marshall Space Flight Center has developed a unique prototype for measuring the liquid level in a tank, employing a novel process. The technology can operate in a wide range of environments, including high and low temperatures and pressures, and is simpler and less expensive than other optical sensing techniques. The instrument also provides far greater accuracy and faster results in cryogenic conditions than typical cryogenic liquid metering methods. It is ideal for cryogenic and non-cryogenic ground tank metering applications, and zero-gravity systems that include stratification or settling techniques.

## BENEFITS

- **Versatile:** Operates at high and low temperatures and pressures, functions in corrosive environments, and provides highly accurate metering for both cryogenic and non-cryogenic liquids
- **Precise:** Allows accurate liquid level measurements to 0.1% of the optical fiber length
- **Safe:** Avoids an explosion hazard—requires no electrical signals in the tank
- **Fast:** Offers a very rapid response time (up to gigahertz data rates), enabling measurement of rapidly changing fluid levels or sloshing liquids
- **Flexible:** Accommodates snaking through access ports or shaping to fit tank contours
- **Economical:** Incorporates directly into a plastic tank, reducing cost and eliminating the need for holes in the tank in some applications

technology solution

# NASA Technology Transfer Program

Bringing NASA Technology Down to Earth

## THE TECHNOLOGY

### What it is

NASA's technology provides highly accurate and versatile liquid level metering in a wide range of operating environments.

NASA's device for measuring liquid levels in tanks was initially developed for rocket engine testing. Scientists needed to determine the amount of cryogenic liquid that was being used in the testing quickly and accurately—data often very difficult to obtain because such systems usually involve constant mixing between gaseous and liquid states, which can lead to turbulent flow, cavitation, and sloshing.

### Why it is better

Other sensors that measure liquid levels in tanks require complicated tank modifications and detection instruments, increasing cost and complexity. Other cryogenic metering systems register the thermal change between liquid and gas fluid phases, limiting accuracy in cryogenic conditions. In contrast to these systems, NASA's device allows operation at high temperatures and pressures in corrosive environments and can precisely measure liquid levels to 0.1% of the sensor length with gigahertz data acquisition rates.



## APPLICATIONS

The technology has several potential applications:

**Aerospace** – Rocket propulsion testing, engine fuel tanks, cryogenic tanks

**Automotive** – Liquid hydrogen fuel tanks, petroleum, gasoline, and liquid natural gas tanks

**Foods and Pharmaceuticals** – High temperature, contamination-free storage and transportation

**Aviation** – Jet engine fuel tanks

## PUBLICATIONS

U.S. Patent No. 8,695,420



National Aeronautics and Space Administration

**Sammy A. Nabors**

**Marshall Space Flight Center**

Huntsville, AL 35812

256.544.5226

[sammy.nabors@nasa.gov](mailto:sammy.nabors@nasa.gov)

<http://technology.nasa.gov/>

**[www.nasa.gov](http://www.nasa.gov)**

NP-2014-08-1159-HQ

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

MFS-32642-1